THE OPEN UNIVERSITY OF SRI LANKA
FACULTY OF ENGINEERING TECHNOLOGY
POSTGRADUATE DIPLOMA IN TECHNOLOGY IN INDUSTRIAL ENGINEERING – LEVEL 7
FINAL EXAMINATION – 2011/2012
MEX 7214 – QUALITY AND RELIABILITY ENGINEERING
DATE : *11 March 2012*
TIME : *0930 hrs – 1230 hrs*
DURATION : *Three (03) hours*

Answer any five (05) questions. All questions carry equal marks. Normal Distribution Table and Exponential Distribution Table are provided.

1. (a) Quality is a term that has been defined in many ways. Individuals, groups of companies and international organizations have attempted to define quality. Discuss two such definitions. You may select one definition from an individual and one from an organization. Support your answer with examples taken from products and services.

   (b) Explain in a stepwise manner how you would achieve quality starting from the definition. You may select one of the definitions of quality to support your answer.

2. Write an account on each of the following statements.

   (a) Quality of a product and quality of a service have the same definition but they have marked differences.

   (b) There will be many deficiencies and inadequacies in formulating product specifications which ultimately affect overall performance of an organization.

3. (a) Explain the terms reliability, availability and maintainability.

   (b) Following data are applied to a proposed hydraulic subsystem.

Part	Failure rate per hour
Check valve	70×10^{-6}
Filter	300×10^{-6}
Relief valve	30×10^{-6}
Transfer valve	1480×10^{-6}
Cylinder	40×10^{-6}
Lines and fittings	80×10^{-6}

If all parts are in series and critical for subsystem success, what is the probability that the subsystem will run for at least 20 hours.

4. (a) Explain Internal customer concept.
How does internal customer concept help in improving relationships between different level of employees in an organization.

(b) Explain the importance of managing supplier quality. What are the basic measures to be taken to improve supplier quality?

5. A company manufacturing packeted items has marked 100 g as the net weight for each pack. A study of the packing process was done and the results showed that the mean net weight of a pack was 101.2 g with a standard deviation of 0.8g. If the net weight is normally distributed, find the answers to the following questions.

(a) Find the percentage of packs whose net weight is between 100g and 102g.

(b) Find the net weight below which 20 percent of the packs fall.

(c) All packs containing less than 100g are rejected.

They are repacked at a cost of Rs. 5 per pack.

If 15000 packs are produced per day what is cost of repacking.

(d) To what mean weight should the pack contents be adjusted if only 1 percent of the packs are to be rejected. Standard deviation remains unchanged.

6. (a) Fraction defective control chart (p-control chart) has to be installed at an important step of a process. Explain in a step-wise manner how you would proceed to install the control chart.

If the company has decided on a maximum allowable fraction defective level, how you would validate the control chart for future use.

(b) A fraction defective control chart has been setup at a particular stage of a process. In setting up the control chart 50 items were inspected each time. The central line of the control chart is 0.02. An inspector took 50 items and found 5 items defective. In terms of statistical control, what is your opinion about the state of the process at this time? If the company specification for defectives is 6% maximum, what is your opinion regarding the use of this control chart for future production?

7. (a) "Control and improvement are like two sides of a coin, they are linked together but they have marked differences".

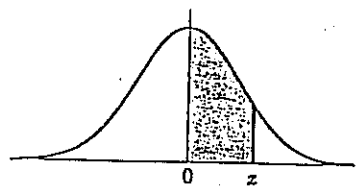
Explain this statement with suitable examples.

(b) "Statistically controlled process may produce products not conforming to specification". Explain this statement.

8. (a) In problem solving methodology, it is important to narrow down a problem and then find root causes. Identify a quality tool for each of the above purposes. Describe one of the quality tools in detail.

(b) A company manufacturing liquid detergents in plastic bottles needed to do a complete study of the bottling process. The company found that the yield was too low due to high variation. As a consultant in quality indicate in a step-wise manner how you would conduct the study.

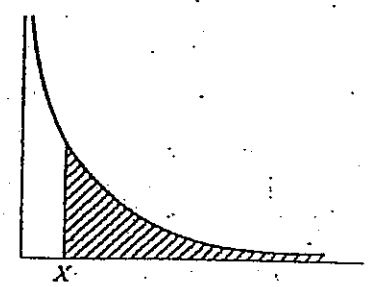
AREAS under the STANDARD NORMAL CURVE from 0 to z



z	0	1	2	3	4	5	6	7	8	9
0.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
0.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0754
0.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.5	.1915	.1950	.1985	.2019	.2054	.2088	.2123	.2157	.2190	.2224
0.6	.2258	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2518	.2549
0.7	.2580	.2612	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
0.8	.2881	.2910	.2939	.2967	.2996	.3023	.3051	.3078	.3106	.3133
0.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990
3.1	.4990	.4991	.4991	.4991	.4992	.4992	.4992	.4992	.4993	.4993
3.2	.4993	.4993	.4994	.4994	.4994	.4994	.4994	.4995	.4995	.4995
3.3	.4995	.4995	.4995	.4996	.4996	.4996	.4996	.4996	.4996	.4997
3.4	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4998
3.5	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998
3.6	.4998	.4998	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.7	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.8	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.9	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000

Table B Exponential distribution values of $e^{-X/\mu}$ for various values*

Fractional parts of the total area (1.000) under the exponential curve greater than X. To illustrate: if X/μ is 0.45, the probability of occurrence for a value greater than X is 0.6376.



$\frac{X}{\mu}$	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	1.000	0.9900	0.9802	0.9704	0.9608	0.9512	0.9418	0.9324	0.9231	0.9139
0.1	0.9048	0.8958	0.8869	0.8781	0.8694	0.8607	0.8521	0.8437	0.8353	0.8270
0.2	0.8187	0.8106	0.8025	0.7945	0.7866	0.7788	0.7711	0.7634	0.7558	0.7483
0.3	0.7408	0.7334	0.7261	0.7189	0.7118	0.7047	0.6977	0.6907	0.6839	0.6771
0.4	0.6703	0.6637	0.6570	0.6505	0.6440	0.6376	0.6313	0.6250	0.6188	0.6126
0.5	0.6065	0.6005	0.5945	0.5886	0.5827	0.5769	0.5712	0.5655	0.5599	0.5543
0.6	0.5488	0.5434	0.5379	0.5326	0.5273	0.5220	0.5169	0.5117	0.5066	0.5016
0.7	0.4966	0.4916	0.4868	0.4819	0.4771	0.4724	0.4677	0.4630	0.4584	0.4538
0.8	0.4493	0.4449	0.4404	0.4360	0.4317	0.4274	0.4232	0.4190	0.4148	0.4107
0.9	0.4066	0.4025	0.3985	0.3946	0.3906	0.3867	0.3829	0.3791	0.3753	0.3716

$\frac{X}{\mu}$	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
1.0	0.3679	0.3329	0.3012	0.2725	0.2466	0.2231	0.2019	0.1827	0.1653	0.1496
2.0	0.1353	0.1225	0.1108	0.1003	0.0907	0.0821	0.0743	0.0672	0.0608	0.0550
3.0	0.0498	0.0450	0.0408	0.0369	0.0334	0.0302	0.0273	0.0247	0.0224	0.0202
4.0	0.0183	0.0166	0.0150	0.0130	0.0123	0.0111	0.0101	0.0091	0.0082	0.0074
5.0	0.0067	0.0061	0.0055	0.0050	0.0045	0.0041	0.0037	0.0033	0.0030	0.0027
6.0	0.0025	0.0022	0.0020	0.0018	0.0017	0.0015	0.0014	0.0012	0.0011	0.0010

*Adapted from S. M. Selby (ed.). *CRC Standard Mathematical Tables*, 17th ed., CRC Press, Cleveland, Ohio, 1969, pp. 201–207.